CLAIMS

Having thus described the invention, what is claimed is:

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(1) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$$DH=K\times Pmax/hmax^2,$$

wherein DH is dynamic hardness, K is constant, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation.

(2) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

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liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=K\times Pmax/hr^2$,

wherein HV is hardness of plastic deformation, K is constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(3) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have dynamic hardness value (DH) from 26 to 30, which is obtained by the following formula:

$DH=K\times Pmax/hmax^2$,

wherein DH is dynamic hardness, K is constant, Pmax is maximum load, and hmax is total maximum variation obtained by adding elastic deformation and plastic deformation,

and wherein said spacers have hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=K\times Pmax/hr^2$,

wherein HV is hardness of plastic deformation, K is constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(4) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have elastic coefficient from 100 to 500 kg/mm^2.

(5) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have linear expansion coefficient which is nearly equal to the coefficient of volume expansion per unit area of the liquid crystal.

(6) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

(7) The liquid crystal display according to claim 1 wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

(8) The liquid crystal display according to claim 2 wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column

density/pixel area)×100

Column density: Total number of columns/total number of pixels

(9) The liquid crystal display according to claim 3 wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

(10) The liquid crystal display according to claim 4 wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

(11) The liquid crystal display according to claim 5 wherein said spacers have column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

(12) A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the lower bottom from 50 to 90%.

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(13) The liquid crystal display according to claim 1 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(14) The liquid crystal display according to claim 2 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(15) The liquid crystal display according to claim 3 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

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(16) The liquid crystal display according to claim 4 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(17) The liquid crystal display according to claim 5 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(18) The liquid crystal display according to claim 6 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(19) The liquid crystal display according to claim 7 wherein said spacers have the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the diameter from 50 to 90%.

(20) The liquid crystal display according to claim 12 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

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(21) The liquid crystal display according to claim 13 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(22) The liquid crystal display according to claim 14 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(23) The liquid crystal display according to claim 15 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(24) The liquid crystal display according to claim 16 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

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(25) The liquid crystal display according to claim 17 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(26) The liquid crystal display according to claim 18 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(27) The liquid crystal display according to claim 19 wherein said spacers have the length of one side of the upper bottom, which is equal to one side of the lower bottom and a horizontal surface in the position decreased by certain ratio from the maximum height of said spacers or the diameter of the upper bottom, which is equal to that of the lower bottom.

(28) A method for providing a liquid crystal display comprising the steps of:

disposing a first and a second substrate facing each other, said first and second substrates each having a display and a non-display region;

selecting a photosensitive resin to regulate a cell gap between the first and the second substrate;

placing spacers comprising said photosensitive resin between the first and the second substrates, said spacers being placed in the non-display region of at least one of the first and the second substrates; and

providing liquid crystal between the first and the second substrates.

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(29) The method according to claim 28 wherein said selecting of a photosensitive resin comprises choosing a photosensitive resin based on at least one of the group consisting of:

(a) a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$$DH=K\times Pmax/hmax^2,$$

wherein DH is dynamic hardness, K is constant, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation;

(b) a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$$HV=K\times Pmax/hr^2,$$

wherein HV is hardness of plastic deformation, K is constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

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(c) dynamic hardness value (DH) from 26 to 30, which is obtained by the following formula:

$DH=K\times Pmax/hmax^2$,

wherein DH is dynamic hardness, K is constant, Pmax is maximum load, and hmax is total maximum variation obtained by adding elastic deformation and plastic deformation, and wherein said spacers have hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=K\times Pmax/hr^2$,

wherein HV is hardness of plastic deformation, K is constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

(d) an elastic coefficient from 100 to 500 kg/mm^2;

a linear expansion coefficient which is nearly equal to the coefficient of volume expansion per unit area of the liquid crystal;

(e) the ratio of one side of the upper bottom to one side of the lower bottom or the ratio of the diameter of the upper bottom to that of the lower bottom from 50 to 90%; and

(f) a column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.